Work Copy
ACT/047/003

FOR THE GOOD OF MANKIND®

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT APPLICATION

PARAHO UTE SHALE OIL FACILITY

UINTAH COUNTY, UTAH

PARAHO DEVELOPMENT CORPORATION
Grand Junction, Colorado 81501

NATIONAL POLLUTANT DISCHARGE
ELIMINATION SYSTEM (NPDES)
PERMIT APPLICATION

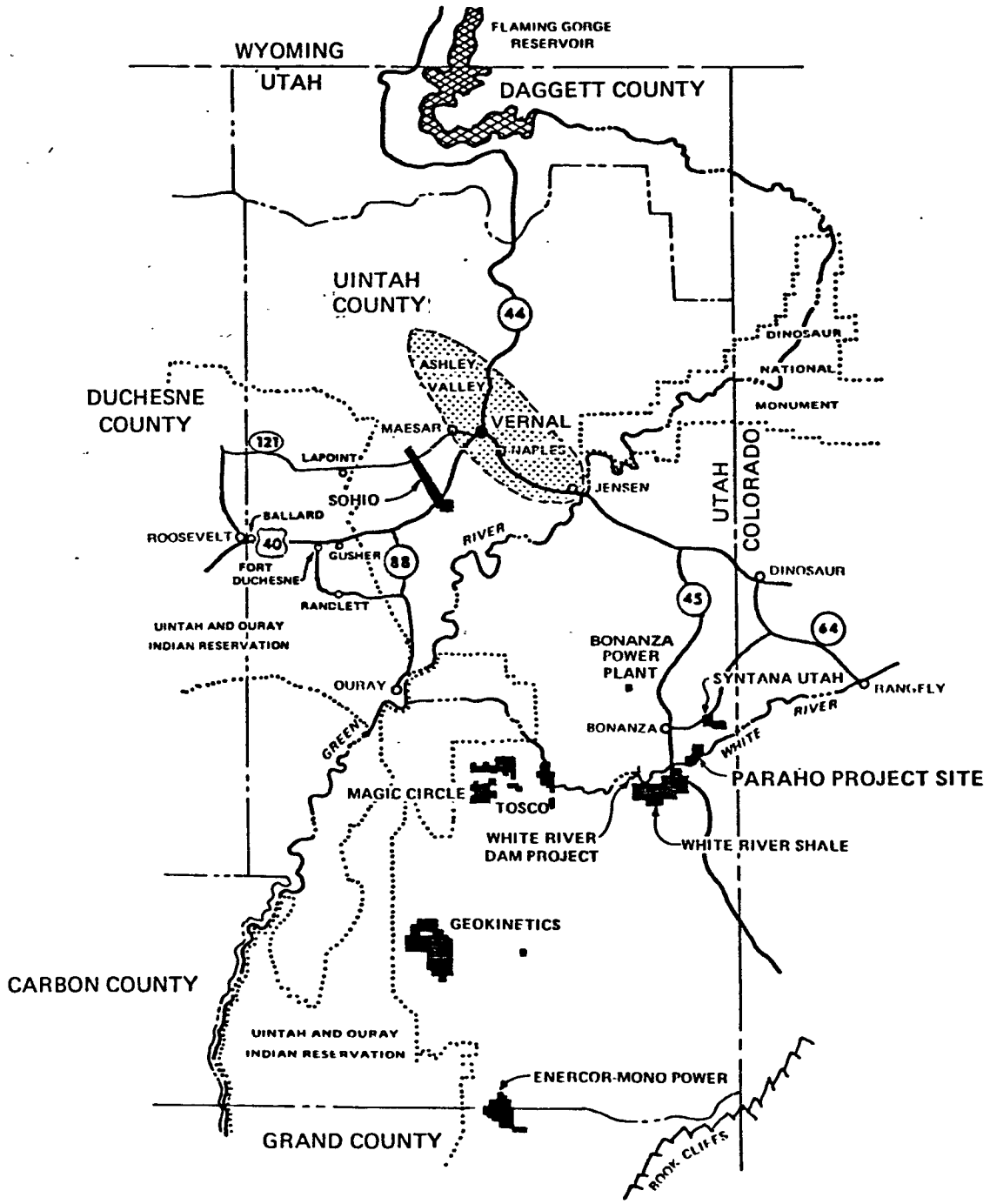
TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

1.0 INTRODUCTION

Paraho Development Corporation (Paraho) plans to construct and operate the Paraho-Ute Shale Oil Facility. The proposed facility will be located in northeastern Utah, approximately 50 miles from Vernal (see Figure 1-1). The tract consists of a 582-acre Utah State Oil Shale Lease, located in Section 32, Township 9 South, Range 25 East, SLBM; and an adjoining 834 acres owned by Skyline Oil Company and under lease to Sohio Shale Oil Company, located in Sections 5, 6, and 7, Township 10 South, Range 25 East, SLBM. Paraho was assigned State Mineral Lease No. 35894 on February 23, 1979 for oil shale extraction on the 582-acre site. Sohio Shale Oil Company will make the 834-acre property available to Paraho for commercial development. A topographic map of the project site is provided in Figure 1-2.

This document presents the plans for the wastewater treatment system associated with the project. The project will be a zero wastewater discharge facility, with all treated wastewater from the facility reused for such purposes as cooling tower makeup, processed shale disposal area wetting, dust control and firewater. All contaminated runoff from the plant process area (see Figure 1-2) will be collected in storm sewers and treated along with process wastewater. The contaminated runoff collection system and associated wastewater retention pond are designed to contain the runoff from a 100-year, 24-hour precipitation event. All contaminated runoff from the edges of the retorted shale disposal pile



PARAHO COMMERCIAL PROJECT

REGIONAL PROJECT LOCATION MAP

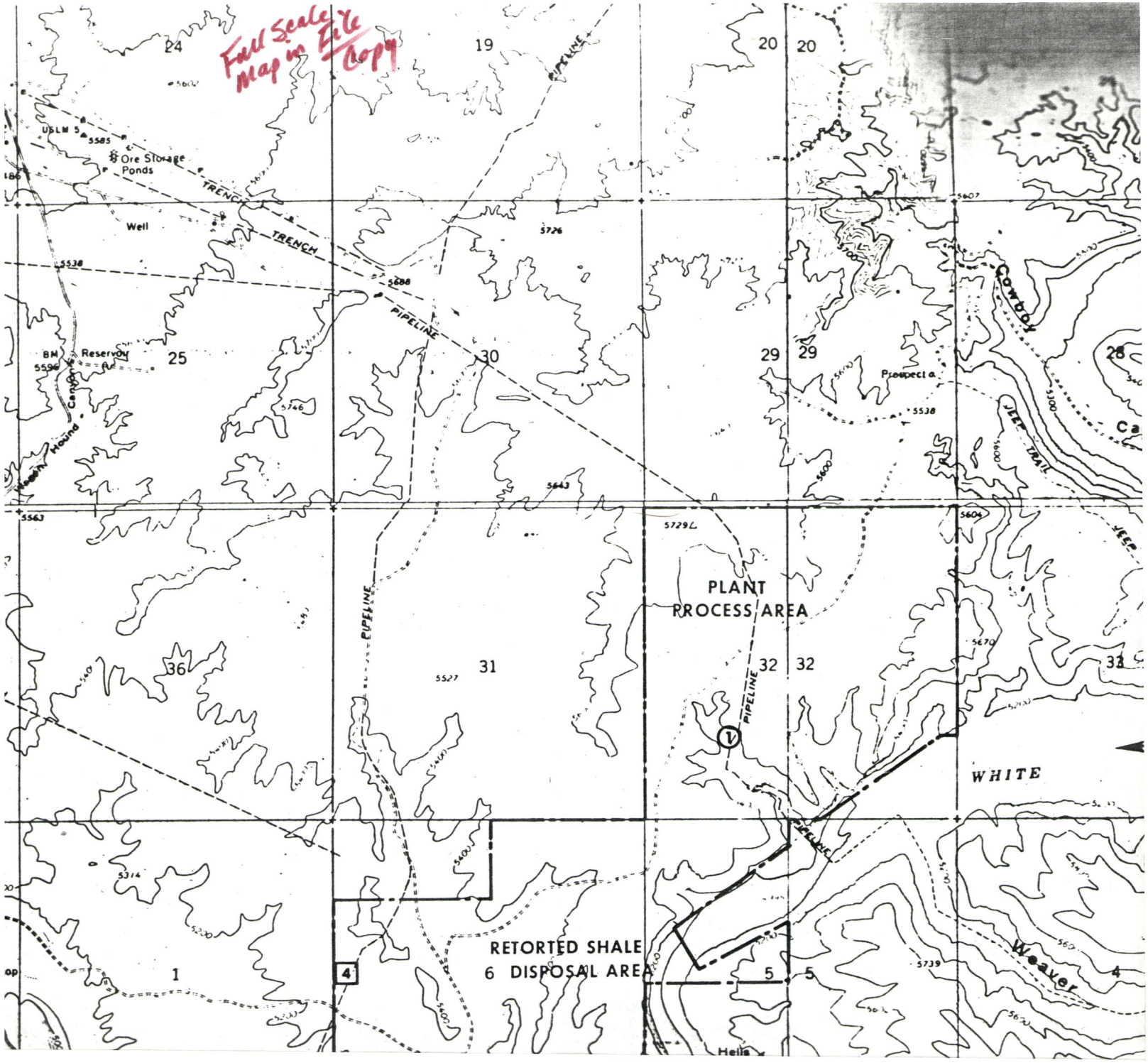
N

0 16 32 Kilometers

0 10 20 Miles

FIGURE 1-1

vtn


Full Scale Map in File Copy
PLANT PROCESS AREA
RETORTED SHALE 6 DISPOSAL AREA
PIPELINE
TRENCH
Ore Storage Ponds
Well
Reservoir
Prospect a
Cowboy
JEEP TRAIL
WHITE
Weaver
24
19
20
25
30
29
36
31
32
33
1
4
5

will be collected in retention ponds designed to contain the 100-year, 24-hour storm runoff. Uncontaminated runoff will be diverted away from the retorted shale disposal areas, and will be directed into natural drainages leading to the White River.

The purpose of this application is to obtain a permit to:

a) authorize emergency discharge from wastewater retention ponds in case of a storm exceeding the 100-year, 24-hour event (2.4 inches per NOAA Atlas 2, Volume VI (Utah), 1973)

b) authorize the discharge of uncontaminated precipitation runoff waters that are diverted away from the retorted shale disposal area.

Figure 1-2 provides the locations of: the three retention pond emergency outfalls and the precipitation runoff diversion outfall.

2.0 GENERAL DESCRIPTION OF THE PROPOSED ACTION

2.1 Project Location

The project site lies on a river-cut terrace above the White River. The terrace is dissected by moderately to extremely steep canyons and slopes gently toward the southwest at a gradient of approximately 5%. The canyon of the White River is the southern site boundary and is deeply incised, with nearly vertical walls up to 500 feet high. Rock outcrops exhibit bench and slope features on the canyon walls. The drainage channels that dissect the terrace run into the river from the project area and are nearly perpendicular to the river at their confluences. These confluences exhibit high, steep canyon walls, with side slopes at 30^{o} to greater than 45^{o}. Elevations of the land surface range from approximately 5,000 to 5,700 feet above sea level.

2.2 Project Description

The Paraho-Ute Shale Oil Facility will consist of an underground mine, three above-ground retorts, facilities for retorted shale disposal, raw shale fines storage, oil upgrading, power generation, product oil storage and transmission, and associated support facilities. At full operation, the facility will produce approximately 42,500 barrels per stream day (BPSD) of upgraded (hydrotreated) oil. The mine is designed to produce 73,875 tons per stream day (TPSD) of oil shale. The mine will be an underground,

room-and-pillar, top heading and bench system. Crushing and screening units are designed to provide 66,490 TPSD of oil shale to the retorts. Raw shale fines (-3/8") are expected to be generated during crushing and screening at a rate of 7,385 TPSD. These will be stored on-site for possible future processing.

Water requirements for the facility are estimated to be 2,156 gallons per minute. A summary water balance showing the sources and uses of this water is presented in Table 2-1. Paraho has letters of intent to purchase water from the State of Utah. An alternative is to obtain water from the Green River, via the Bonanza Power Plant.

2.3 Facility Layout

A plot plan of the overall facility is shown in Figure 2-1. The plant process area, located in Section 32, is shown in detail in Figure 2-2. This area includes the retorts, hydrotreaters, mine surface facilities, oil storage tanks, wastewater treatment area, and associated facilities.

2.4 Project Schedule

Project construction will begin early in 1983 following receipt of environmental permits for the commercial facility. The construction schedule is provided in Figure 2-3.

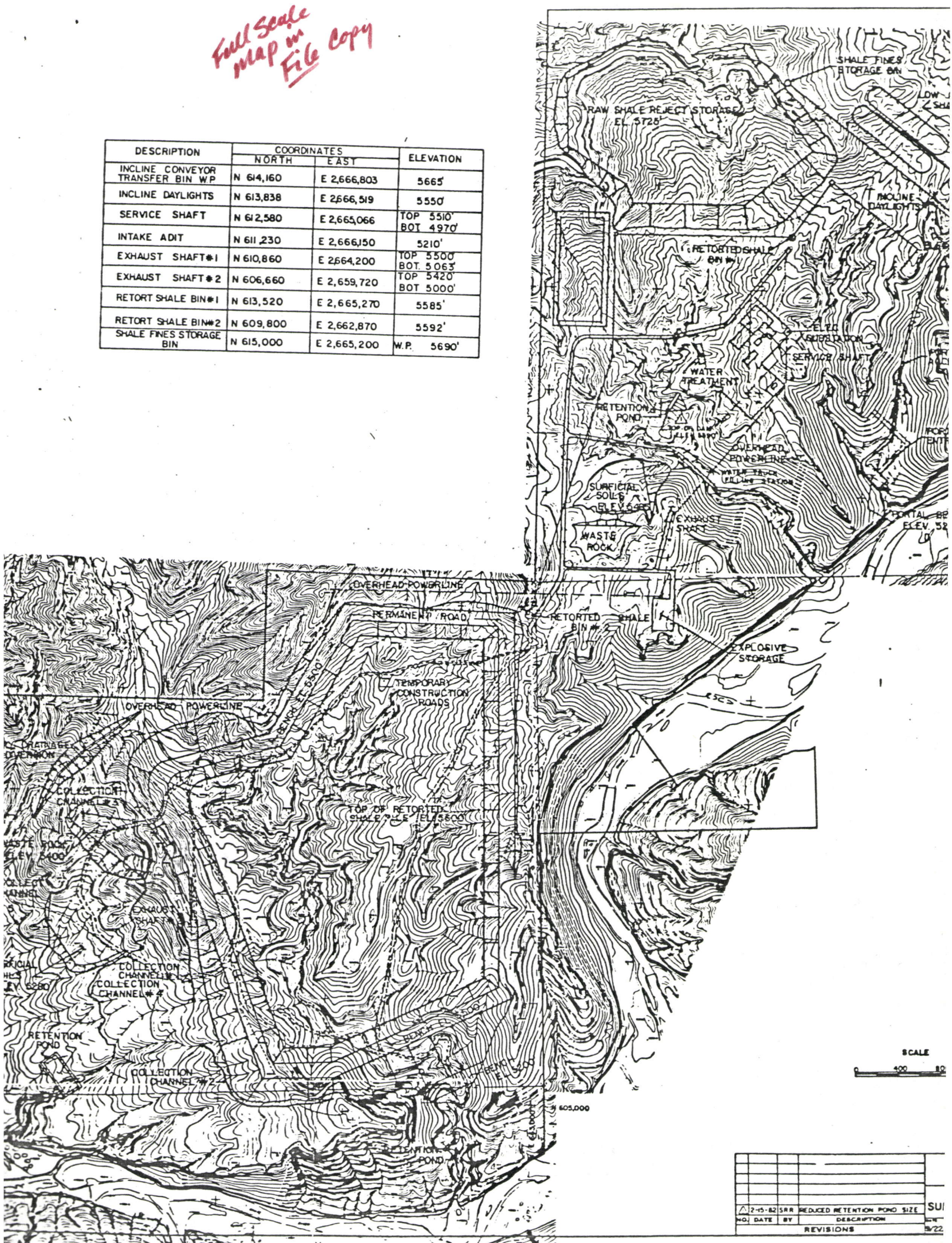
TABLE 2-1

PARAHO-UTE FACILITY SUMMARY WATER BALANCE

	QUANTITY	
WATER USES	GPM	AC-FT/YR
Cooling Tower Evaporation	863	1,389
Processed Shale Disposal	725	1,167
Underground Mine	205	330
Belts and Dust Control	192	309
Retention Pond Evaporation	4	6
Waste Water Treatment Plant Evaporation	7	11
Process Users	128	206
Miscellaneous Evaporative Steam Losses	12	19
Sulfur Recovery	20	32
Total Consumptive Use	2,156	3,469
WATER SOURCES		
Raw Water Supply	1,713	2,756
Process Area Runoff	57	92
Gas Clean-up	218	351
Retort Product Water	168	270
Total	2,156	3,469

Full Scale Map on File Copy

DESCRIPTION	COORDINATES		ELEVATION
	NORTH	EAST	
INCLINE CONVEYOR TRANSFER BIN W.P	N 614,160	E 2,666,803	5665'
INCLINE DAYLIGHTS	N 613,838	E 2666,519	5550'
SERVICE SHAFT	N 612,580	E 2,665,066	TOP 5510' BOT 4970'
INTAKE ADIT	N 611,230	E 2,666,150	5210'
EXHAUST SHAFT#1	N 610,860	E 2664,200	TOP 5500' BOT. 5063'
EXHAUST SHAFT#2	N 606,660	E 2,659,720	TOP 5420' BOT 5000'
RETORT SHALE BIN#1	N 613,520	E 2,665,270	5585'
RETORT SHALE BIN#2	N 609,800	E 2,662,870	5592'
SHALE FINES STORAGE BIN	N 615,000	E 2,665,200	W.P. 5690'



NO.	DATE	BY	DESCRIPTION
△	2-15-82	SRR	REDUCED RETENTION POND SIZE

REVISIONS

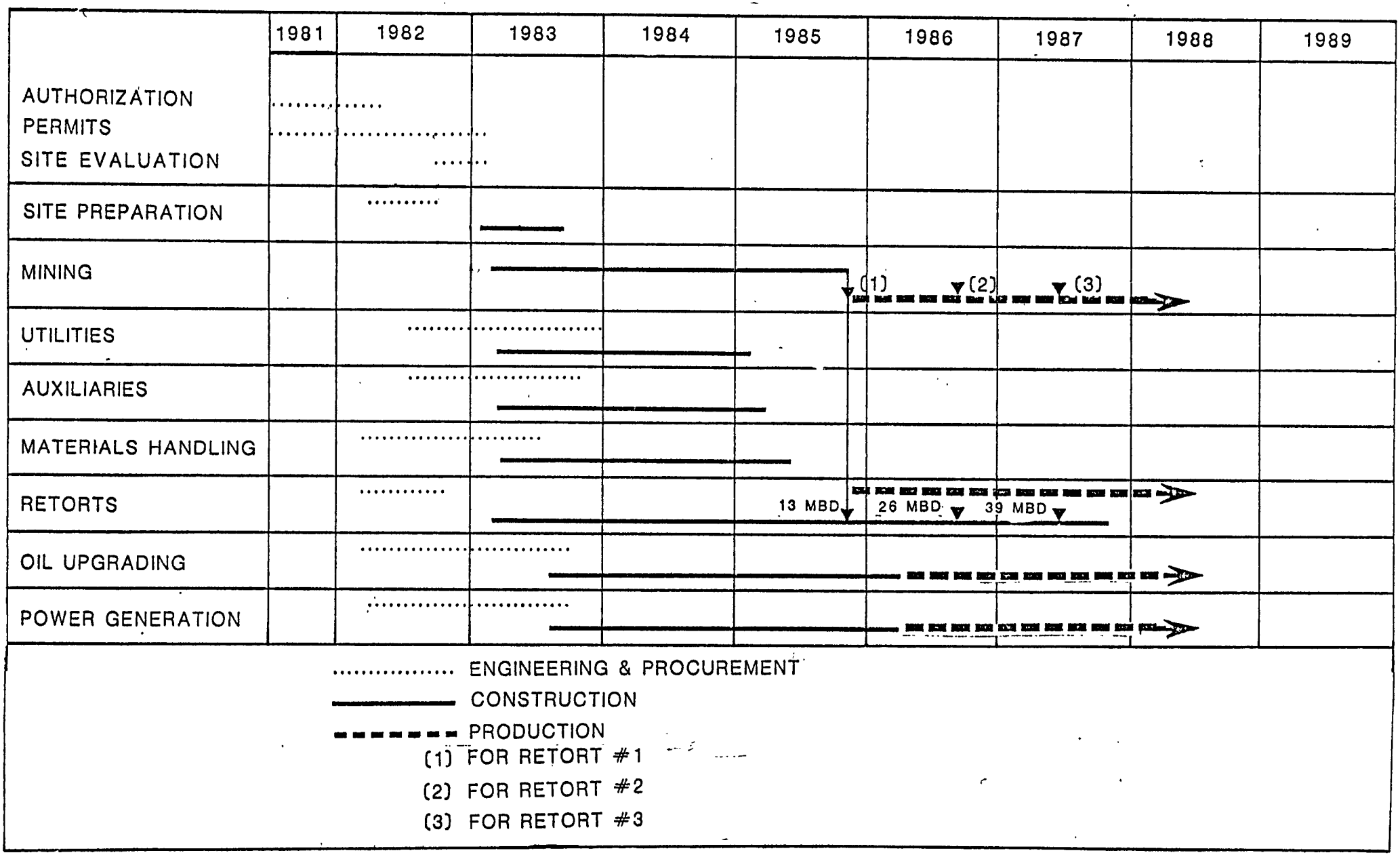
SECTION 32

1	MINE CONVEYOR DRIVE HOUSE	18	TANK FARM	36	FLARE
2	MINE CONVEYOR	19	HYDROTREATER	36	MINE SURFACE FACILITIES
3	MINE SURGE BIN	20	SANITARY W.W. TREATMENT	37	RETORTED SHALE DISPOSAL CONV.
4	EMERGENCY RAW SHALE STORAGE	21	FIREWATER POND	38	FUEL OIL STORAGE
5	CRUSHING AND SCREENING STATION	22	EQUALIZATION BASIN		
6	CENTRAL CONTROL ROOM & LAB	23	PROCESS W.W. TREATMENT	40	MINE ENTRANCE & VENT FANS
7	CONVEYOR JUNCTION HOUSES	24	RETENTION POND	41	GILSONITE CLAIM
8	PREPARED SHALE COVERED STORAGE	25	THICKENER/DIGESTER	42	MAINTENANCE SHOPS
9	DISTRIBUTION BIN	26	AIR COMP. PLANT STEAM & INERT GAS	43	GATEHOUSE
10	SCREENING STATION	27	STORAGE YARD	44	RIVER WATER TREATMENT
11	SAMPLING AND WEIGHING HOUSES	28	RECEIVING AND STORE ROOM	45	RETORTED SHALE DISPOSAL HOPPER

FIGURE 2.3

PARAHO DEVELOPMENT CORPORATION

BASE SCHEDULE



3.0 HYDROLOGICAL RESOURCES

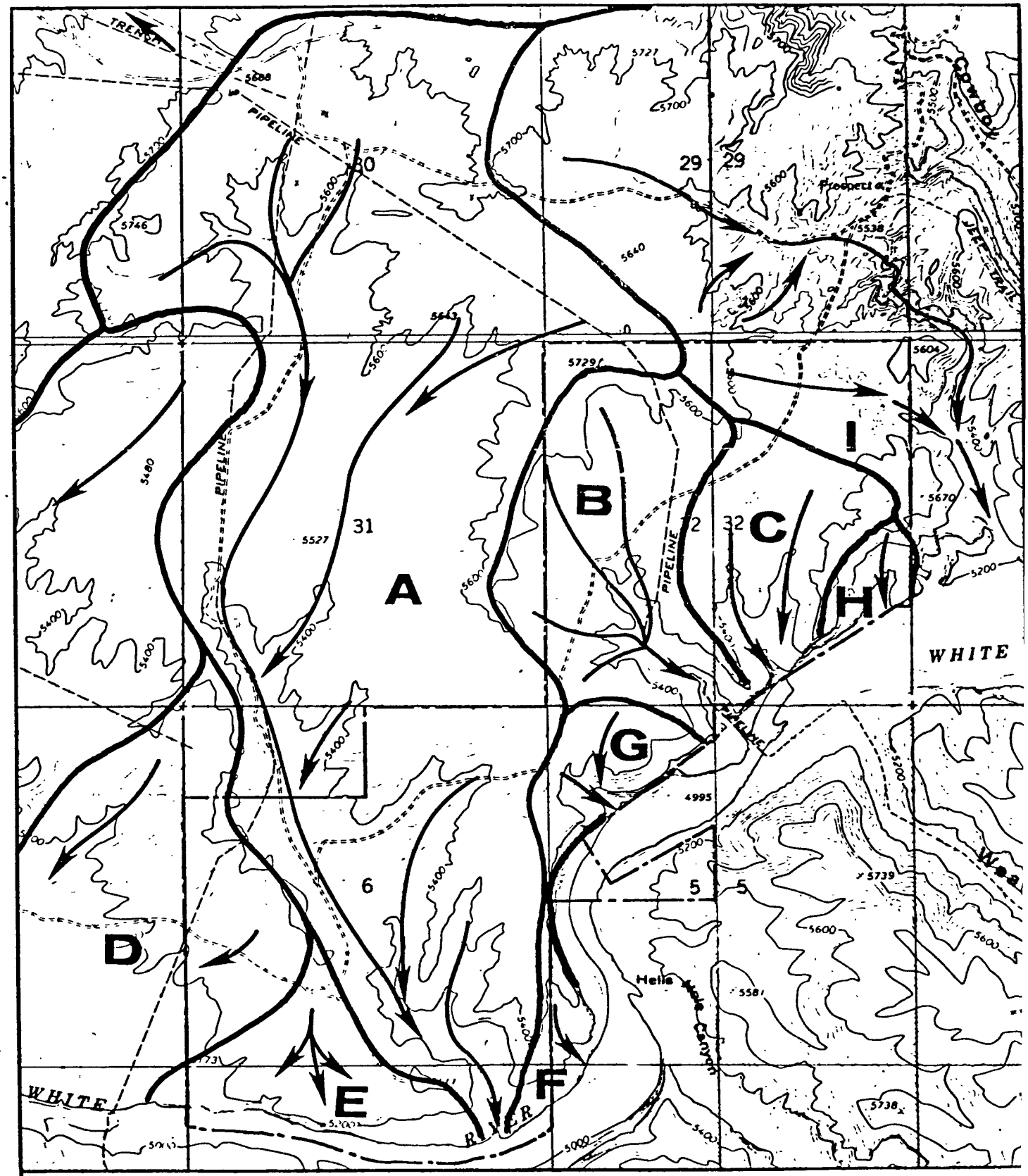
3.1 Surface Water

The only surface water body near the Paraho-Ute facility is the White River, which forms the southern boundary of Section 7 of the project site. The White River originates in a mountainous area of western Colorado and flows westward into Utah to its confluence with the Green River, approximately 35 miles west of the project site. The annual average flow of the White River is 695 cubic feet per second (cfs). The peak flows (2,500 to 4,000 cfs) usually occur from mid-May through mid-July and are usually generated by either rapid snowmelt in the upper watershed or intense convective storms. During most of the year, there is a sustained flow of about 200 to 500 cfs.

Surface waters occurring on the Paraho site are limited to runoff resulting from precipitation events. Figure 3-1 delineates the drainage areas potentially affected by site development. Table 3-1 shows approximate areal extent of each of the drainage areas.

3.2 Runoff Diversion

The retorted shale disposal pile in Section 6 would prevent the runoff of precipitation through its normal channel; therefore, a drainage diversion has been designed to allow the uncontaminated runoff to flow to the White River in an adjacent drainage. The approximate location of the diversion cut in the northwest corner



LEGEND

DRAINAGE DIVIDE

DIRECTION OF SURFACE RUNOFF FLOW

X DRAINAGE AREAS POTENTIALLY AFFECTED BY SITE DEVELOPMENT

PARAHO COMMERCIAL SITE
DRAINAGE AREAS

FIGURE 3-1

TABLE 3-1

SIZES OF DRAINAGE AREAS

Drainage	Acres
A	1,650
B	300
C	180
D	470
E	130
F	40
G	80
H	50
I	160

of Section 6 is shown in Figure 2-1. The diversion cut will be an approximately 1,500 foot long open-cut channel, about 20 feet wide at the base and 130 feet deep at the maximum section, with a wall slope of 45°.

The diversion cut has been designed to allow the discharge of the 100-year, 24-hour storm of 2.4 inches. Under these conditions, the maximum volume of runoff water from drainage area A (see Figure 3-1), upstream from the diversion cut, is estimated to be 102 acre-feet. The peak discharge, assuming a Soil Conservation Service Type II rainfall distribution, is estimated to be 765 cubic feet per second.

4.0 WASTEWATER SOURCES AND CHARACTERISTICS

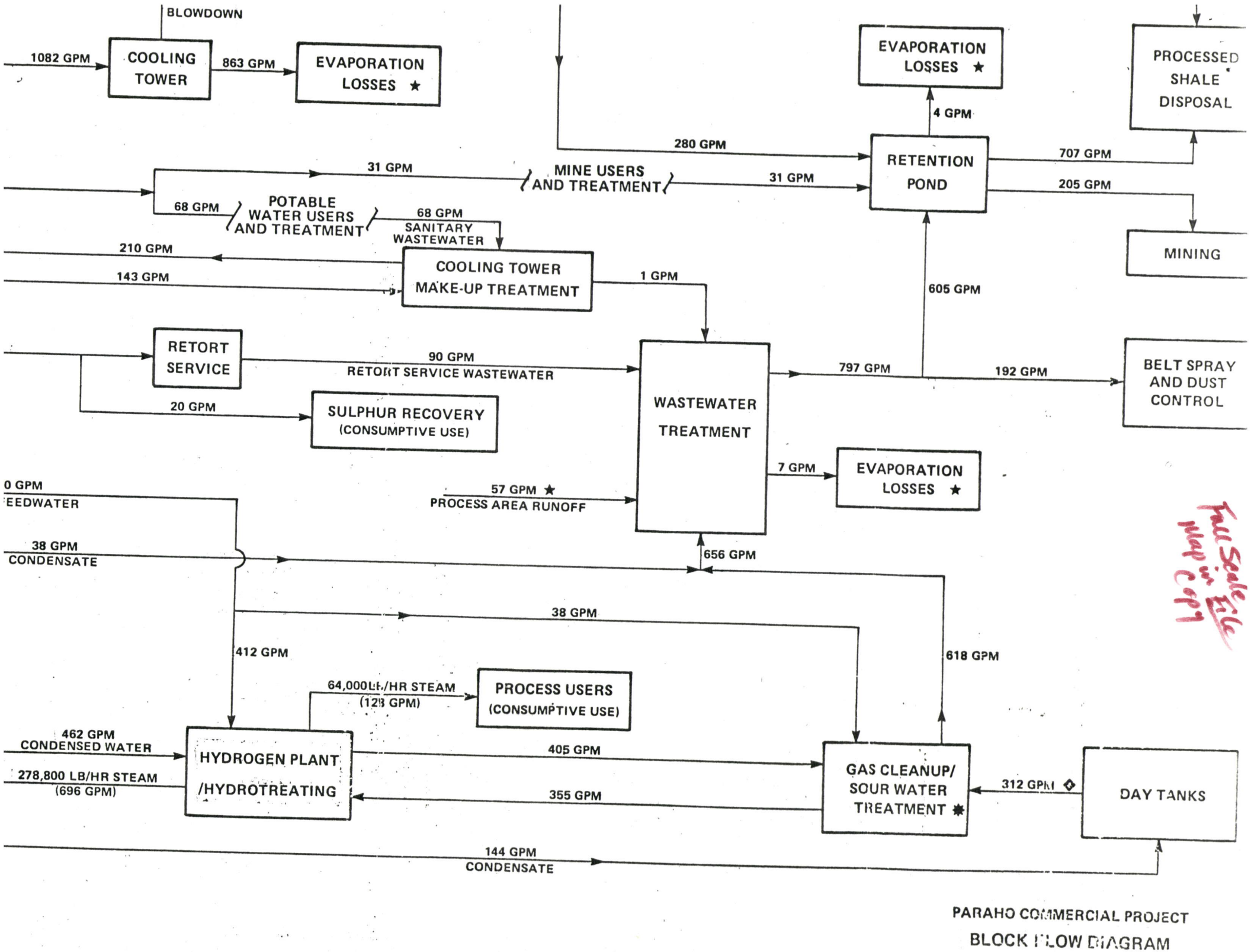
A block flow diagram for all steam and water systems associated with the proposed project is provided in Figure 4-1. The flow rates are based on maximum facility operation (i.e. 42,500 BPSD of upgraded oil). Water systems include water supply and treatment, wastewater collection and treatment and cooling water supply. This section discusses the sources of wastewater. Wastewater collection and treatment is discussed in Section 5.0.

Three types of wastewater streams will be associated with the proposed commercial facility: (1) organic wastewaters from process facilities; (2) inorganic wastewaters from water treatment units and boiler and cooling tower blowdown, and (3) sanitary wastewaters.

4.1 Organic Wastewaters

Organic wastewaters are generated primarily during oil recovery and upgrading (hydrotreating) and product gas cleanup. Oil recovery wastewaters will be produced in the retort and recovered following oil/water separation in day storage tanks at a rate of 312 gallons per minute (gpm). Washwater from the hydrotreater will be produced at a rate of 405 gpm. Product gas cleanup wastewaters will be produced in the ammonia removal units and will include ammonia water and condensed water from ammonia scrubbers.

Wastewater characterization studies have been conducted on water co-produced with crude product oil from the Paraho retort at the



Full Scale Map in File Copy

PARAHO COMMERCIAL PROJECT

BLOCK FLOW DIAGRAM

Anvil Points test facility near Rifle, Colorado. The wastewater sampled was stored in tankage with shale oil over a period of years, and as a result, represents a composite wastewater rather than water actually produced at the time of sampling. Table 4-1 provides the range of values from these tests for various wastewater parameters. Further information is available in Paraho Environmental Data (U.S. Department of Energy, Report No. DOE/EV-0085, Washington, D.C., June 1980). These data are presented as a means of indicating the potential characteristics of the oil recovery wastewater. Characteristics of other wastewater streams entering sour water treatment, such as ammonia water and washwater from the hydrotreater, are not currently available. Expected characteristics of the effluent from sour water treatment are provided in Table 4-2. This effluent will serve as one of several influents to wastewater treatment.

Other sources of organic wastewaters will include retort service wastewater (90 gpm), runoff collected in storm sewers from process areas (57 gpm), and blowdown from the Stretford unit (normally zero gpm). These wastewaters do not contain ammonia and hydrogen sulfide and thus will not be treated in sour water treatment, but will be sent directly to wastewater treatment.

4.2 Inorganic Wastewaters

Inorganic wastewaters which will be generated and treated include boiler blowdown (40 gpm), water treatment filter backwash (103 gpm). boiler cleaning wastes (normally 0 gpm), boiler feedwater

TABLE 4-1

ESTIMATED PRODUCT WATER* CHARACTERISTICS

Parameter	Concentration (mg/l)
Biochemical Oxygen Demand	5,000 - 12,000
Chemical Oxygen Demand	17,000 - 132,000
Oil and Grease	30 - 90
Total Suspended Solids	10 - 700

* Product Water is water co-produced with shale oil during retorting.

TABLE 4-2

ANTICIPATED CHARACTERISTICS OF

SOUR WATER TREATMENT EFFLUENT

(INFLUENT TO WASTEWATER TREATMENT)

Parameter	
Flow	620 gpm
Chemical Oxygen Demand	17,736 mg/l
Biochemical Oxygen Demand	8,868 mg/l
Total Suspended Solids	< 50 mg/l
Temperature	100°F
pH	8 - 9

pretreatment backwash (61 gpm), cooling tower blowdown (219 gpm), and water treatment lime sludge (18 gpm).

4.3 Sanitary Wastewaters

Sanitary wastewaters will be generated at several surface facilities (68 gpm) and in the mine (31 gpm).

5.0 WASTEWATER TREATMENT

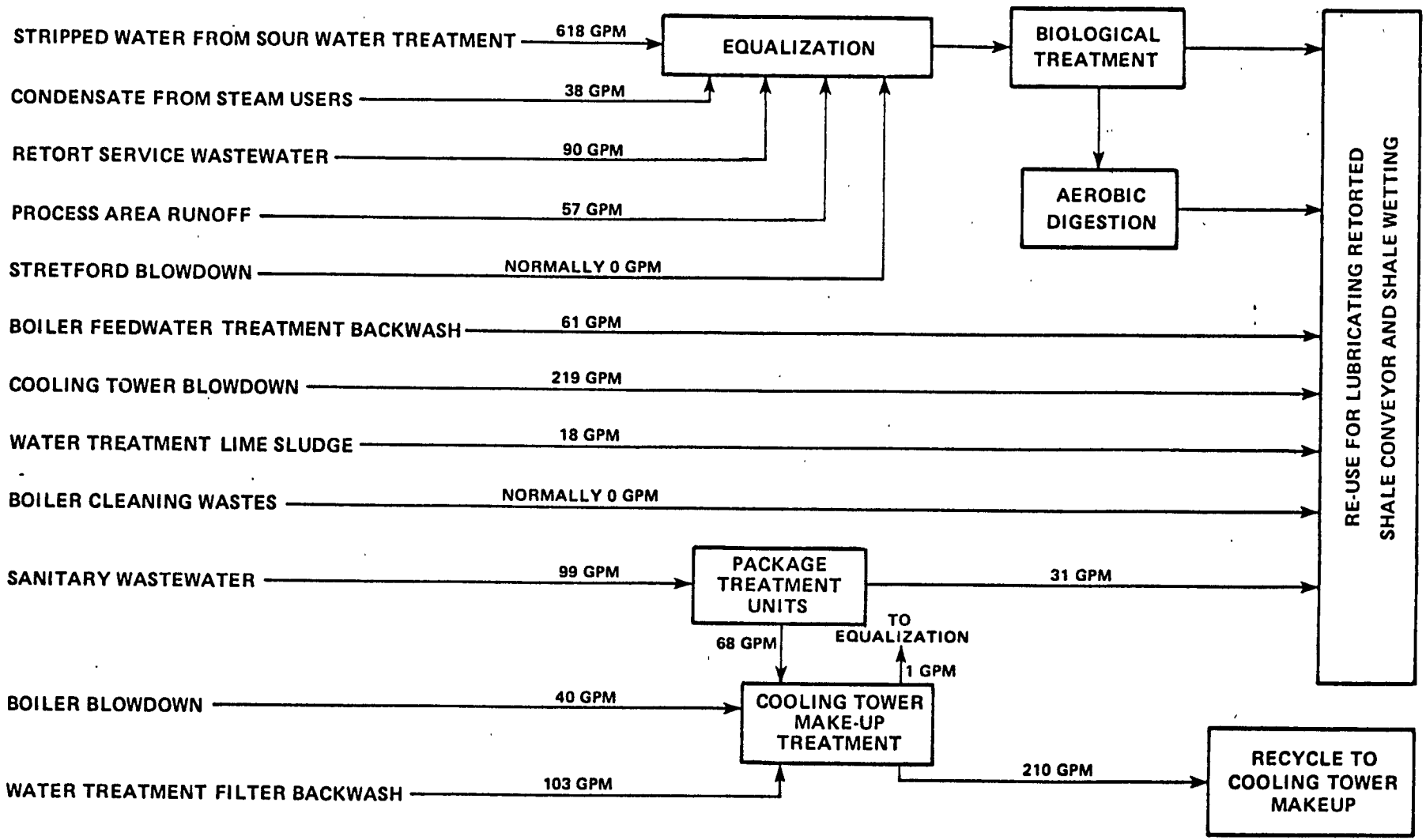
The wastewater treatment system consists of essentially three treatment schemes, each designed to treat one of the three types of wastewaters discussed in Section 4.0. A block flow diagram of the wastewater treatment system is depicted in Figure 5-1. The major influent to wastewater treatment is stripped water from sour water treatment, as described in Section 5.1.

5.1 Sour Water Treatment

Retort water separated from product oil in storage tanks, washwater from the hydrotreater, condensed water from ammonia removal, and ammonia water from the ammonia removal unit are the waste streams treated in the sour water plant. The sour water treatment scheme is depicted in Figure 5-2. This treatment scheme is commonly used in the refining industry.

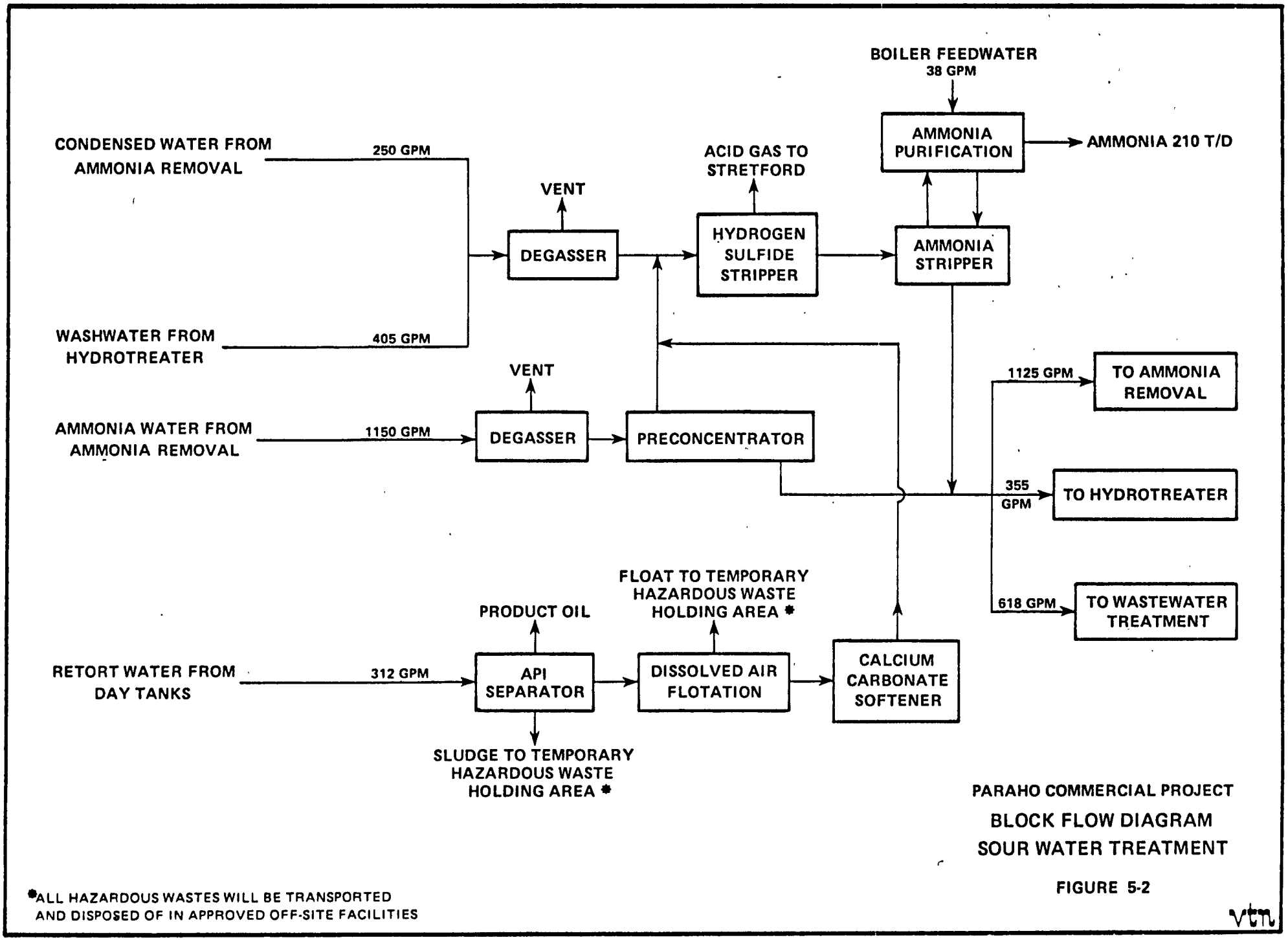
Retort water from storage tanks is produced at a rate of 312 gpm. This water is treated in a gravity oil/water separator and dissolved air flotation unit for oil and grease removal, followed by a $CaCO_3$ softener (optional). This stream will then be mixed with other sour water streams. Design criteria for retort water pretreatment are provided in Table 5-1.

The major feed to the sour water treatment unit is ammonia-rich water (1,150 gpm) from ammonia removal. This stream is degassed



PARAHO COMMERCIAL PROJECT
BLOCK FLOW DIAGRAM
WASTEWATER TREATMENT

FIGURE 5-1



PARAHO COMMERCIAL PROJECT

BLOCK FLOW DIAGRAM
SOUR WATER TREATMENT

FIGURE 5-2

*ALL HAZARDOUS WASTES WILL BE TRANSPORTED AND DISPOSED OF IN APPROVED OFF-SITE FACILITIES

TABLE 5-1

DESIGN CRITERIA FOR RETORT WATER PRETREATMENT

API Separators

Flow: 312 gpm design avg.
Two parallel tanks
Width: 10 ft.
Length: 35 ft.
Depth: 6 ft.
Volume: 31,500 gals.

Dissolved Air Flotation

Flow: 312 gpm design avg.
Flocculation: 15' x 8' x 6'
Flotation: 15' x 30' x 6'
Pressurization Tank: 6' diam., 4 ft. height

Carbonate Softening

Optional (information not available)

and put through a preconcentrator tower. The preconcentrator tower produces a stripped water stream and an overhead water stream containing hydrogen sulfide and ammonia. The overhead stream is combined with condensed water from the ammonia removal unit (250 gpm), hydrotreater washwater (405 gpm) and the treated retort water from storage tanks (312 gpm) and sent to the hydrogen sulfide stripper. Hydrogen sulfide and carbon dioxide are removed overhead and sent to a Stretford unit for sulfur recovery. Approximately 2,125 lbs/hr of H_2S are recovered. The bottoms from the hydrogen sulfide stripper contain ammonia. The ammonia is removed in an ammonia stripping column. The ammonia stream is purified in two scrubbing columns to remove water and hydrogen sulfide, then compressed and condensed to a salable anhydrous ammonia product at a rate of approximately 210 T/D.

The resultant stripped water from the preconcentrator and ammonia stripper will have a combined flow rate of 2,098 gpm, and an ammonia concentration of less than 30 mg/l. This water will be split into three streams. Most of the stripped water (1,125 gpm) will be recycled to the ammonia removal unit. Some stripped water (355 gpm) will be recycled to the hydrotreater. The remainder (618 gpm) will be combined with condensed water from miscellaneous steam users (38 gpm) (see Figure 4-1) and sent to wastewater treatment, as described in Section 5.2.

5.2 Organic Wastewater Treatment

Organic wastewaters include stripped water from sour water treatment (618 gpm), condensate from steam users (38 gpm), retort service wastewater (90 gpm), process area runoff (57 gpm), and Stretford unit blowdown (normally zero gpm). These will be combined in a 1.1 million gallon equalization basin. Four 15-hp mixers will be included to provide a homogeneous wastewater prior to treatment. A floating oil skimmer will be included to remove any oil which may be present.

The equalized wastewater flows by gravity through a distribution box where it is mixed with recycle from the biological treatment units and split into eight streams. The wastewater then flows to one of eight oxygenators, where oxygen (generated in a cryogenic oxygen plant) is added at a rate of 33 TPD and subsequently processed in the biological treatment system, which consists of fluidized bed reactors.

Effluent exiting the biological treatment system will be stored in a retention pond (see Figure 4-1). Water stored in this pond will be used for processed shale disposal conveyor cooling and lubrication and for spray wetting during storage and disposal of raw shale fines and retorted shale. The anticipated characteristics of the water quality of this pond are provided in Table 5-2.

Biomass exiting the biological treatment system will be separated from the fluidized bed reactor growth media (sand) in eight

TABLE 5-2

ANTICIPATED WATER QUALITY CHARACTERISTICS

OF

WASTEWATER RETENTION POND

Parameter	
Biochemical Oxygen Demand (5 day)	63 mg/l
Chemical Oxygen Demand	1,000 mg/l
Total Suspended Solids	95 mg/l
Ammonia	44 mg/l
pH	6.5-8

sand/biomass separators. The growth media is returned to the reactors and the resultant sludge (220 gpm) will be thickened in gravity thickeners. Supernatant (110 gpm) from the thickeners will be returned to the equalization basin while the underflow (110 gpm) will be stabilized in two 0.75 million gallon aerobic digester basins. Oxygen from the cryogenic oxygen plant will be supplied to these basins at a rate of 12 TPD. The resultant stabilized sludge, at 1.3% solids, will be combined with sanitary sludge and water treatment lime sludge, and applied to the retorted shale for spray wetting.

5.3 Inorganic Wastewater Treatment

Inorganic wastewaters include boiler feedwater treatment backwash (61 gpm), cooling tower blowdown (219 gpm), and boiler cleaning wastes (normally 0 gpm). These wastewaters will be stored in the retention pond for use in shale wetting of the processed shale disposal pile.

Water treatment lime sludge (18 gpm) will be combined with treated sludges from sanitary wastewater treatment and organic wastewater treatment and applied to the retorted shale disposal pile for spray wetting.

Water treatment filter backwash (103 gpm) and boiler blowdown (40 gpm) will be combined with treated sanitary wastewater (68 gpm), clarified, filtered, and reused as cooling tower makeup at a rate of 210 gpm.

5.4 Sanitary Wastewater Treatment

Two sanitary wastewater treatment units are incorporated into the project design. One will be designed to handle all of the mine (surface and underground) requirements, while the other will be sized for all other surface facility sanitary wastewaters. Each will be a package sewage treatment plant.

The treatment plant for the mine will be an extended aeration system capable of treating an average daily flow of 45,000 gallons (31 gpm) with an anticipated BOD_5 of 126 mg/l. A detention time of 16½ hours will be provided based on design flow. A comminutor and by-pass bar screen will be provided prior to the aeration compartment, while settling tanks and chlorine disinfection will follow biotreatment. The effluent will be sent to the retention pond discussed in Section 5.2 and subsequently used for retorted shale spraying, firewater and conveyor belt cooling.

All sanitary wastewater from the remainder of the project surface facilities will be treated in a package wastewater treatment system designed to treat an average daily flow of 68 gpm. The system will consist of a comminutor, aeration compartment, settling tank, sludge return system, skimmer, air supply system, aerobic digestor and chlorine disinfection. Effluent from this system will be recycled for cooling tower makeup.

Sludges from each of the sanitary wastewater treatment facilities will be combined with water treatment lime sludge and sludge from

the organic wastewater treatment process and applied to the retorted shale for spray wetting.